Europäisches Patentamt
European Patent Office
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(11) Publication number: **0 155 109 A2**

EUROPEAN PATENT APPLICATION

Application number: 85301272.2

Date of filing: 26.02.85

(51) Int. Cl.⁴: **B 65 D 81/06**

Priority: 07.03.84 US 587182

Date of publication of application: 18.09.85 Bulletin 85/38

Designated Contracting States: BE CH DE FR GB IT LI NL SE

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Method of packing objects and packing therefor.

A cushion packing for protecting an object to be packed in :ontainer and methods for the use thereof are disclosed. The shion packing comprises a dimensionally stable outer shell 2, 28 or 36) forming a chamber (18) therein of a prede- mined configuration related to the object to be protected d related to a container for packaging same, a lower density am material (14, 30 or 38) disposed within and substantially ing and conforming to the shape of said chamber (18) formed said outer shell (12), said foam material having a molded nsity of less than or equal to 1.5 pounds per cubic foot when sposed in said chamber, and said outer shell filled with said am material being adapted to be disposed in said container r said object and placed in contact with a portion of said iject to thereby support and protect said object when pack- ed in said container against shock and vibrational loads.

One factor which must be considered in designing particular packaging, particularly with respect to fragile objects, is the peak deceleration load which the object or article can withstand as a result of an externally applied force (such as being dropped) without breakage or damage. More particularly, the function of the packaging material is to absorb and dissipate harmlessly an externally applied force such that the shock or vibration experienced by the object will be below that which would result in damage to the article. For instance, fragile objects can generally only withstand low peak deceleration loads, while more sturdy objects are capable of withstanding greater peak decelaration loads. Therefore, in designing cushion packaging one must keep in mind that the packaging materials must be designed so as to provide a cushion or shock absorption characteristic such that the peak deceleration load which the object will experience is less than the peak deceleration load which will injure or damage the article. Often times, manufacturers of objects or articles will specify that the packaging materials must be such that the peak deceleration load which will be experienced by the object does not exceed a certain limit if dropped from a given height.

The peak deceleration loading which an object will experience if packed in a particular packaging material and dropped from a certain height can be varied by a number of factors, including the thickness of the cushion or packaging material and the static load on the cushioning material when the packaged article is at rest. For instance, peak deceleration values experienced by an object packaged in certain types of packaging material can be decreased by providing a greater thickness of cushion or packaging material, which will thus provide a greater distance within which to absorb and dissipate dynamic forces applied externally, such as when the packaged article is dropped.

technique wherein a shipping carton or the like is initially partially filled with an expandable and uncured polyurethane foam mixture in a liquid or slurry form. Upon introduction into the carton, the foam mixture begins to expand or rise in comparison to its original liquid volume. Before expansion and curing is completed, the foam mixture is covered with a nondimensionally stable flexible plastic sheet, such as polyethylene film, and the object to be packed is then placed thereon. The expanding foam mixture follows any contours of the product to thereby begin to form a custom mold around the bottom half of the product. A second flexible sheet of polyethylene film or the like is then placed over the object, and the balance of the container is filled with additional expandable and uncured polyurethane foam mixture, again introduced in a liquid or slurry form. The container is closed and sealed, and the polyurethane foam mixture expands against the contours of the object and carton to encapsulate the product in a strong lightweight foam to thereby provide a customized protective package or packing. The customized pack is reusable after shipment for storing and/or further shipment of articles having the same general shape and configuration. Such a technique is shown generally in United States Patent No. 3,618,287 to Gobhai. Additionally, variations of such a technique are shown in United States Patent Nos. 2,780,350; 2,897,641 and Re 24,767, as well as in U.S. Patent Nos. 3,222,843 and 3,415,364.

An additional variation of this packing technique is one in which packaging cushions are custom premolded. In this technique, a thin film or sheet, such as polyethylene film, is placed or draped over or in a standarized specially designed mold which reflects the shape of the object to be packed. The lined mold is then filled with an expandable and uncured polyurethane foam mixture or the like, and the mold is then closed until the foam expands and sets to provide a molded cushion. After curing has been completed, the molded cushion covered with

container or carton. However, with such polystyrene and polyethylene rigid foams, the same or equivalent cushioning characteristics are not achievable. Basically, with the low density polyurethane foams which are used for providing cushioning protection for fragile objects and under low static load conditions, only the foam material directly beneath and in contact with the object to be protected provides the cushioning benefit or characteristics, with the surrounding portions of the foam simply serving to maintain an integral packaging cushion.

A further disadvantage of both of the above-discussed packaging techniques is that the resulting cushion or packaging which is formed is not particularly attractive in that the covering film or sheet assumes all types of crinkles and folds. Here it should be noted that such films or sheets in prior art packaging techniques and methods are essentially used to serve as a mold release to prevent adherence between the polyurethane foam and the object or article to be packaged in the customized cushion. If such a film or sheet were not used, the polyurethane foam mixture forming the packing or cushion would simply adhere to the product and/or the mold cavity, which obviously is undesirable, particularly if it is desired to reuse the customized cushions or packing or the molds. Also, the foam mixture must be introduced or placed in the polyethylene sheeting at the plant or location where the mold cavity is located since, if the polyethylene film is removed from the mold, it loses its molded shape. United States Patent No. 3,187,069 teaches the manufacture of a cushioning or packing material wherein a flexible sheet is used for a mold release for foam blown into a mold cavity.

Also concerned with the cushion packaging field is U.S. Patent No. 4,339,039 which is directed to impact resistant foam cushion packages. In accordance with this patent, preformed foam cushions are covered by an outer shell having air vents therein and are secured to the inside of a carton or container. The air vents in the

directed to the manufacture of furniture articles in which a thin sheet or film is vaccum formed into a shell of a desired configuration and into which an expandable uncured foam mixture is then introduced, the open end of the shell being covered with a paper backing sheet. Also, U.S. Patent No. 4,114,213 discloses vacuum forming an outer layer and placing foam thereinto to form an upholstery article. Furthermore, U.S. Patent Nos. 3,630,819 and 4,122,203 are both directed to building panels in which PVC or other sheet materials are initially vaccum formed and filled with expandable foam materials to produce building panels having a decorative outer surface, while U.S. Patent No. 4,350,544 is directed to vacuum formation of a rigid PVC sheet which is attached to a backing with foam material added or introduced thereinto for making padded panels. Further, U.S. Patent No. 2,977,639 discloses the use of an outer layer or sheet of polystyrene formed into a desired shape and then filled with foam for making refrigerator panels, lightweight shipping containers, life belts, etc. U.S. Patent Nos. 3,420,923; 2,955,972; 2,959,508; 3,691,265; 3,867,240 and 3,729,370 are all directed to vaccum formed sheets of plastic material into which expandable, uncured foam material, such as a polyurethane foam mixture, is introduced and adheres to the vacuum formed sheet. These references are basically directed to the manufacture of crash pads, head rests, decorative panels and seat cushions for the automobile industry. U.S. Patent Nos. 3,623,931; 3,379,800; 4,244,764; and 4,248,646 all disclose toilet seat constructions in which a sheet of plastic material is initially vacuum formed into a desired shape and an expandable foam mixture then dispensed thereinto. U.S. Patent Nos. 3,419,455 and 3,703,571 disclose the manufacture of rigid decorative articles comprised of an outer shell and having foam material dispensed thereinto. U.S. Patent No. 3,912,107 discloses a somewhat similar technique used in the construction or manufacture of liquid storage tanks. Finally, U.S. Patent

of a predetermined configuration related to the object to be protected and related to a container for packaging same, a low density foam material disposed within and substantially filling and conforming to the shape of said chamber formed in said outer shell, said foam material having a molded density of less than or equal to 1.5 pounds per cubic foot when disposed in said chamber and said outer shell filled with said foam material being adapted to be disposed in said container for said object and placed in contact with a portion of said object to thereby support and protect said object when packaged in said container against shock and vibrational loads.

According to the present invention, there is provided a method of packing an object, comprising the steps of thermoforming a thermoformable material into a dimensionally stable shell of a predetermined configuration having a chamber therein, said predetermined configuration being related to the object to be packed and to a selected container, filling said chamber with a foam material so as to have a molded density of less than or equal to one and one half pounds per cubic foot to provide a foam filled cushion packing element, positioning said foam filled cushion packing element in said selected container, and placing said object to be packed in said container in contact with said foam filled cushion packing element so that said object is supported and protected by said cushion packing element against shock and vibrational loads.

The combination of a dimensionally stable outer shell and a low density foam has been found to produce a cushion packaging material which is capable of supporting greater static loads than that of the foam absent the dimensionally stable shell and which, at the same time, exhibits substantially the same or improved cushioning characteristics in terms of the dynamic forces or loads capable of being dissipated. This is believed to result from the use of an outer dimensionally stable shell which serves to maintain the integrity of the foam material

Figure 6 is a cross-sectional view of a packing application employing the packing elements constructed in accordance with Figure 5.

Figure 7 is a graphic representation of a standard drop test comparison of peak deceleration vs. static stress for a cushion packing constructed in accordance with the principles of the present invention and prior art cushion packing of the type comprising a low density polyurethane foam without a dimensionally stable outer shell, the drop height being 30 inches, the cushion thickness being 2 inches, and the foam material utilized being one having a free rise density of .4 pounds per cubic foot.

Figure 8 is a graphic representation similar to that of Figure 7, but for cushion thicknesses of 3 inches, the drop height and foam material being the same as utilized with respect to Figure 7.

Figure 9 is a graphic representation similar to that of Figures 7 and 8, but for a differently configured cushion packing and in which the foam material utilized had a free rise density of .85 pounds per square foot. The drop height was 24 inches and the cushion thickness was 3 inches.

Figure 10 is a graphic representation similar to that of Figure 9, but for a drop height of 36 inches, the configuration, foam material and cushion thickness being the same as utilized with respect to Figure 9.

Figure 11 is a graphic representation of peak deceleration vs. static stress for numerous prior art cushion packing materials and cushion packing material constructed in accordance with the principles of the present invention, the various curves representing first drop data only.

The cushion packing of the present invention is constructed from a dimensionally stable outer shell having a chamber or cavity therein of a predetermined configuration which is filled with a low density foam material. The term "dimensionally stable" as used herein

Low density polyurethane foams are generally produced by combining a multi-functional isocyanate or prepolymer component with a polyol component along with, if desired, catylsts, blowing agents, surfactants, flame retardants and/or other conventional adjuvants, to form an expandable uncured foam mixture. The expandable, uncured foam mixture is generally introduced into a mold chamber or cavity, or other confining object, in a liquid or slurry state where it then expands as it cures to substantially fill the mold cavity or chamber. As can be appreciated, the mold density for the foam material is dependent on the amount of mixture introduced into the cavity and the size of the cavity. For packing type applications to provide low peak deceleration load protection, the final mold density of polyurethane foam material (i.e., after curing) is generally approximately 1.5 pounds per cubic foot or less.

The outer dimensionally stable shell utilized in the cushion packaging of the present invention serves to provide the mold cavity or chamber for the foam material. The shell is designed so as to be sufficiently flexible so as to transmit any impact or dynamic forces to the foam contained therein which will provide the cushioning protection. In other words, the shell by itself is not sufficiently strong or of desired cushioning characteristics so as to provide any substantial cushioning benefits in and of itself. At the same time, in accordance with the present invention, the outer shell should be sufficiently strong and stiff so as to hold and maintain its shape when it is not otherwise supported in a mold cavity or filled with foam material. Preferably, the outer shell has a nominal thickness (i.e., before formation) on the order of 6-50 mils and more preferably on the order of 10-30 mils, and is made from a suitable material such that it will be sufficiently flexible to transmit impact or dynamic forces to the foam material

uncured foam mixture, in a liquid or slurry form, into the chamber formed by the dimensionally stable outer shell, the cavity or chamber then being closed while the foam material expands and cures to substantially and completely fill and conform to the shape of the chamber defined by the dimensionally stable shell.

In accordance with the present invention the outer shell component serves to maintain the integrity of the low density foam material contained therewithin, especially when subjected to multiple impacts or shock loads. This is also believed to be particularly important in minimizing or resisting permanent deformation of the foam material. That is, conventional low density foam cushion packing (which does not include a dimensionally stable outer shell) often has a tendency to deform permanently after shock loads, e.g., by flattening out and/or breaking apart. This permanent deformation or destruction generally worsens with multiple shock loadings. The provision of the outer shell tends to minimize or resist such permanent deformation and destruction, and thus insure that the desired quantity and configuration of foam material is maintained in order to provide the desired cushioning characteristics. Also, in those instances where the cushion packing includes recessed portions in which a part of the object is received, the outer shell is believed to bring into play a greater amount of foam material for absorbing and dissipating any dynamic forces which the cushion packing material supporting the object to be protected might experience. That is, while conventional cushion packing having recessed areas generally only brings into play that portion of the foam material which is in contact with the object and which is located between the point or location of impact and the portion of the foam material in contact with the object, in accordance with the present invention a greater amount of foam material is brought into play to provide cushioning protection. This is believed to be achieved as a result of the use of the dimensionally

believed to be obtained also as a result of the combination of a dimensionally stable outer shell and a low density foam contained therewithin.

The result achieved with the present invention is in direct contrast to that which was generally accepted and expected in the cushion packaging industry. Specifically, persons skilled in the art of cushion packing were of the opinion that the use of a dimensionally stable, relatively hard shell for containing a low density foam material would not provide the desired cushioning characteristics, it being thought by such persons that at best only the equivalent or slightly lower cushioning benefits would be obtained for the same static loading of. cushion packages. However, in spite of such thoughts, the present inventors forged ahead and discovered that the combination of a dimensionally stable outer shell with a low density foam material provided in the cavity thereof achieved improved cushioning characteristics, providing in essence equivalent or improved cushioning protection at higher static loadings. This thus affords the capability of providing better performance at lower or comparable costs, and in addition, affords the capability of providing suitable low density foam cushion packing for use with those objects in which only relatively high static stress loadings are feasible or practical. The improved performance is believed to result from the fact that the outer shell tends to maintain the integrity and shape of the foam material during use. In particular, the outer shell resists permanent deformation or destruction so that the desired quantity and configuration of the foam material for providing desired cushioning protection is maintained. In addition, in those instances in which the cushion packing is configured to have surrounding portions of foam material which are not in contact with the object or located directly between location of impact and the contact with the object, the outer shell is believed to have a load spreading effect which tends to bring into

article placed thereon, or was introduced into a specially designed standardized mold lined with a thin film or sheet, the specially designed mold reflecting the shape of the object to be packed. In such prior applications, the resulting cushion or packaging was not particularly attractive since the thin film or sheet of plastic assumes all types of wrinkles and folds. With the present invention, however, the dimensionally stable, preformed shell can be filled with an expanding foam mixture by packing personnel at the end user site to provide an aesthetically pleasing cushion packing, an advantage which heretofore was not obtainable.

Refering now to the figures, and more particularly Figures 1 and 2, there is illustrated therein a cushion packing element 10 constructed in accordance with the principles of the present invention. The packing element 10 includes a thermoformed dimensionally stable outer shell 12 having a cavity or chamber 18 therein of a predetermined configuration which is substantially filled with a low density foam material 14. More particularly, the dimensionally stable outer shell 12 is preferably formed from a plastic sheet material, such as PVC or polyethylene, via means of a conventional thermoforming process so as to include a recess 16 therein which is configured to closely approximate a portion of an object to be supported and protected thereby. After thermoforming of the outer shell 12, a suitable foam mixture in an unexpanded uncured state, such as for example a polyurethane foam mixture, is introduced into the cavity or chamber 18 in a liquid or slurry form. The open end of the cavity 18 is then closed as the foam material expands and cures to substantially completely fill and conform to the shape of the chamber 18 defined by the shell 12. The amount of foam material introduced into the chamber 18 is controlled so that the molded density of the cured foam contained within the shell 12 is approximately 1.5 pounds per cubic foot or less. It will be appreciated that the final molded density is dependent upon the amount of foam

removed from the ends of the keyboard, and saved for further shipping and/or storage.

It will be appreciated from reference to Figures 1-3 that the particular object to be supported and protected by the cushion packing elements 10 and 20, namely the keyboard K, is supported and protected so as to be capable of absorbing shock or vibration loadings in substantially all directions when the keyboard K and packing elements 10, 20 are placed or packed in the suitable shipping container or box B. More particularly, it will be noted that the bottom and top of the keyboard K as illustrated in Figure 3 are located inwardly from the top and bottom surfaces of the box B, while the ends and sides of the keyboard K are located inwardly of the inner end and side walls of the box B. Thus, if the box B is dropped so that it lands on its bottom wall, dissipation of the dynamic forces or impact loadings will be provided by the lower sections or portions of the cushion packing elements 10 and 20. Similarly, if the box B is dropped so that one of the side walls impacts the ground, protection will be provided by the corresponding end sections of the cushion packing element 10, 20. Still further, if the box B is dropped so as to land on one end surface, the side portion of the corresponding cushion packing elements 10 or 20 would provide shock absorbing protection for the keyboard K. Finally, it will be appreciated that a drop of the box B so as to land on or impact on one edge or corner would bring into play corresponding portions of the cushion packing elements 10, 20. Thus, protection against shock and/or vibration will be provided for virtually any type of shock loading such as might occur if the box B is dropped or subjected to vibration during shipment and/or storage.

The degree of protection which will be provided by the cushion packing elements 10, 20 is dependent upon a number of factors. One particularly important factor or consideration to be taken into account in designing any cushion packing material is the peak deceleration which

The shell 28 forms a recess 32 therein for accommodating and supporting the lower half of a computer disc pack which is to be protected. A similarly shaped packing element (not shown) would be provided for placement over the top half of the computer disc pack before placement of the disc pack and cushion packings within a suitable carton or container.

Aside from the configurations for packing elements as heretofore shown and described, it is well within the skill of one of ordinary skill in the art to configure differently shaped packing elements for different applications, the essential feature bringing such packing elements within the scope of the present invention being the combination of a dimensionally stable outer shell having a chamber or cavity therein of a predetermined configuration which is substantially filled with a low density foam material, i.e., a foam material having a density of less than or equal to 1.5 pounds per cubic foot. The particular configurations for the outer dimensionally stable shells, and thus the configurations for the various packing elements, would be dependent upon the conventional considerations in determining the peak deceleration loadings for which protection is to be provided in conventional manners, based upon peak deceleration loading vs. static stress for cushioning packings in accordance with the present invention. In this regard, as noted hereinabove, with the cushion packings in accordance with the present invention, essentially equivalent or improved cushioning benefits in terms of accommodation of low peak deceleration loadings can be achieved at higher static stresses or loadings, which in turn permits the utilization of less foam material for accomplishing essentially equivalent or improved cushioning benefits. The techniques for designing particular configurations for packing elements based upon satisfaction of particular peak loading requirements can be achieved utilizing packing elements in accordance with

elements 34 all have the same general configuration and are designed and placed in a container or carton C so that the object E to be packed and protected will be spaced from the walls of the container C. More particularly, in the embodiment shown in Figures 5 and 6, the packing elements 34 are configured as truncated pyramids in which the exposed foam surface comprises the base of the packing elements 34. The exposed foam surface of the formed packing elements 34 may be coated with a suitable adhesive, not illustrated, so that the packing element can be adhered to the inner surface of the carton C. It will be appreciated from Figures 5 and 6 that the packing elements 34 are designed so that the truncated surface (i.e., the surface opposite from the base or exposed foam surface) thereof will be contacted entirely by the object E to be packed. In other words, no recessed area is provided in the outer surface of the shell 36 to receive a particular portion or segment of the object E to be protected, in contrast to the packing elements 10, 20 and 26 shown in Figures 1-4. The thickness or height of the packing elements 34 is chosen in relation to the size of the container C and object E to be packed so that, when the packing elements 34 are strategically placed at points within the container C to support a particular object, such as a piece of electronic equipment E, and the flaps of the container C are closed, the electronic equipment E will be securely maintained in position for shipment.

Thus, it will be appreciated that the packing elements 34 serve essentially as compression members for supporting the object to be protected. While packing elements 34 generally would not be subjected to mechanical shear type forces such as the packing elements 10, 20 and 26 (since the entire truncated surface of the elements 34 will be loaded or contacted by the object E), the provision of the outer dimensionally stable shell 36 serves to protect the packing elements 34 from permanent deformation when in use. This is believed to be the result of the shell component 36 insuring that the integrity and

foam material but not employing a dimensionally stable outer shell. A Rutgers test cushion, as known in the industry, is one which is approximately twelve inches square and has a symmetrical center recess of approximately eight inches square. The end portion of the cushion, i.e., the portion outside or surrounding the recess, is two inches in height above the recess, and the thickness of the cushion beneath the recess portion is variable for particular tests or curves. For the data represented in Figure 7, the thickness beneath the recess portion was two inches, while for the data represented in Figure 8 the thickness was three inches. Also, for the data shown in each of the Figures 7 and 8 the drop height was thirty inches. In addition, for the data shown in each of the Figures 7 and 8, the particular foam material utilized comprised "Instapak-40" foam sold by Sealed Air Corporation. This polyurethane foam mixture has a free rise density of .4 pounds per cubic foot. The molded foam density with respect to the Rutgers test cushions of both the prior art and the present invention was approximately .68 pounds per cubic foot.

The solid and dashed lines illustrated in Figures 7 and 8 represent test data taken with respect to Rutgers test cushions in which the foam material was covered with a thin, nondimensionally stable flexible polyethylene film which mainly served to prevent adherence of the foam material to the mold cavity in which the test cushion was produced. The test cushions were subjected to several drops from the stated height of 30 inches, represented by the lines labeled drops 1, 2, 3, 4, and 5, for different static stresses or loads, and the peak deceleration loadings, in G's, were determined. The curves were then generated from the resulting test data. Thus, it will be appreciated that the solid and dotted line curves of Figures 7 and 8 represent the peak deceleration loads experienced by objects packed with conventional low density foam cushions characteristic of the prior art in

second drops. Further, as additional drop tests are performed on the same material, a significant improvement in terms of cushioning benefits is realized with the present invention in comparison to the prior art cushions. Specifically, with respect to multiple drops, there is a marked shift to the right of the curve so that multiple drop performance is better with the cushion packings of the present invention. In this regard, the improvement enjoyed by the packing cushion in accordance with the present invention which includes a dimensionally stable outer shell is much more markedly apparent with reference to Figure 8 wherein the peak deceleration characteristics experienced on the object are significantly lower on the third, fourth, and fifth drop tests. Also, the rate of rise of the curves representing peak deceleration in G's vs. static stress are markedly sharper with the foam material alone than with the cushion packing of the present invention.

Therefore, it will be appreciated that the object to be packaged is protected in a better manner with the present invention. Also, it will be appreciated from both Figures 7 and 8 that the benefits achieved with the present invention are more pronounced at higher cushion thicknesses, which are used to provide very low peak deceleration loadings which an object will experience. In other words, when the cushion thickness is three inches as opposed to being two inches, the benefits achieved with the present invention are substantially the same with respect to first drop test data but significantly improved for multiple test drop data particularly at the higher number of drops.

Thus, it will be appreciated from Figures 7 and 8 that the marked improvement in accommodating the peak deceleration loading characteristics by the combination of a dimensionally stable outer shell with a low density foam, as compared to the foam itself, graphically illustrates the unexpected result obtained with the present invention; unexpected since those of ordinary

comparison to the prior art type cushions in which no dimensionally stable shell is provided. Specifically, the peak deceleration experienced by the object to be protected with the cushion packing of the present invention, for a given static stress, is equivalent or improved for first and second drops over prior art type compression cushions and is significantly improved for third, fourth and fifth drops, particularly at higher static stresses. Further, the improvement provided by the cushion packing in accordance with the present invention which includes a dimensionally stable outer shell is much more significant at higher drop heights. Indeed, as is apparent from Figure 10, the peak deceleration experienced by the object is significantly lower for the cushion packing of the present invention for all drops when the static stress is greater than .5 pounds per square inch, with the degree of improvement in comparison to the prior art type cushion increasing as the static stress increases and as the number of drops increases.

To put the teachings of the present invention in proper perspective in regard to other materials known in the prior art for use in connection with cushion packaging, reference is made to Figure 11 which represents first drop data for a thirty-six inch drop height, a three inch cushion thickness, and compression test cushion shapes. The data shown in each case is for a single drop for an 8 by 8 inch by 3 inch thick compression type test cushion, with the exception of the prior art "polyurethane foam having film covering" cushion and the present invention test cushion. The test data for these later two test cushions was derived with respect to the same test cushion used to generate the data shown in Figures 9 and 10 in which the test cushions were approximately 5 by 5 inches by 3 inches thick, and in which the molded density of the foam was approximately 1.1 pounds per cubic foot. It is to be noted that although there are differences in dimensions between the cushions used for the present invention and that for certain of the prior art materials,

significantly higher static stresses. This is most significant when it is realized that the static stresses relate to the amount of foam material which is provided in contact with the object to be supported and cushioned. Accordingly, at higher static stresses, less material needs to be provided directly in contact with the object to be supported, which can thus result in a reduction in the cost of the required foam material. As noted above, such equivalent or improved peak deceleration characteristics in accordance with the present invention are believed to result from the fact that the dimensionally stable outer shell serves to maintain the integrity and configuration of the foam material. Moreover, with some objects, such as certain electronic equipment, it is not feasible or practical to increase the amount of contact area in order to provide a lower static stress. For example, with some products, the static stress cannot practically be lower than 1.0 pounds per square inch. Thus, often times conventional low density polyurethane cushion packing cannot be used in connection with such products. However, with the present invention, it is now possible to provide relatively inexpensive cushion packing for use in connection with such types of products. Still further, as illustrated in Figures 7-10 which include multiple drop test data, significant and more dramatic improvements in cushioning benefits for multiple drops are afforded by the cushion packings in accordance with the present invention in comparison to conventional prior art type low density foam cushion packing without an outer shell. In particular, the peak deceleration experienced by the object to be protected as the number of drops or shock loadings increases will not increase as to as great an extent as occurs with conventional low density foam cushioning packing.

Still further, as noted above, in accordance with the present invention, the dimensionally stable outer shells, which form an integral part of the cushion packings in accordance with the present invention, may be

Also in accordance with the present invention there is provided a method of packing objects comprising the steps of thermoforming a thermoformable material to form a dimensionally stable outer shell having therein a chamber of a predetermined configuration, and filling the chamber with a foam material so as to have a molded density of less than or equal to 1.5 pounds per cubic foot. Thereafter, selected ones of a plurality of such dimensionally stable shells filled with said foam material are positioned about an object to be packaged and enclosed within a selected container to thereby cushion and protect the object from shock or vibrational loadings. In accordance with an aspect of such method, the dimensionally stable outer shells can be nested together and shipped to another location where they are separated and then filled with the foam material.

While the preferred embodiments of the present invention have been shown and described, it will be understood that such are merely illustrative and that changes may be made without departing from the scope of the invention as claimed.

dimensionally stable shells prior to the filling thereof with said foam material.

5. The cushion packing in accordance with any one of the preceding claims, further characterized by adhesive means disposed thereon for securing said packing to a selected surface of said container.

6. The cushion packing in accordance with any one of the preceding claims, characterized in that said dimensionally stable shell comprises an opaque material.

7. The cushion packing in accordance with any one of the preceding claims, characterized in that said foam material is introduced into said chamber in an uncured and expandable state, said foam material expanding and curing within said chamber so as to substantially conform to said predetermined configuration of said chamber.

8. The cushion packing in accordance with any one of the preceding claims, characterized in that said foam material is of the polyurethane foam type.

9. The cushion packing in accordance with any one of Claims 1-4 and 6-8, characterized in that said outer shell filled with said foam material is adhered to a selected surface of said container by means of said foam material.

10. The cushion packing in accordance with any one of the preceding claims, characterized in that said foam material is adhesively secured to said outer shell in said chamber thereof.

11. The cushion packing in accordance with any one of the preceding claims, characterized in that said

17. The method in accordance with Claim 16, characterized in that said steps of thermoforming and filling are performed a plurality of times to produce a plurality of said foam filled cushion packing elements, and wherein said step of positioning comprises positioning said plurality of foam filled cushion packing elements in said selected container, and said step of placing comprises placing said object in contact with said plurality of said cushion packing elements.

18. The method in accordance with Claim 17, further characterized in that said step of positioning comprises adhering said plurality of cushion packing elements to selected surfaces of said container before said step of packing.

19. The method in accordance with Claim 16, 17 or 18, characterized in that said step of filling comprises introducing said foam material in an uncured and expandable state into said chambers in said dimensionally stable shells, and said step of adhering comprises placing said shells with said uncured expandable foam material in said chambers thereof against said selected surfaces of said container before said foam material completes its expanding and curing whereby said foam material will adhere to said selected surfaces of said container.

20. The method in accordance with any one of Claims 16-19, characterized in that said step of thermoforming comprises vacuum forming said thermoformable material into said dimensionally stable shell.

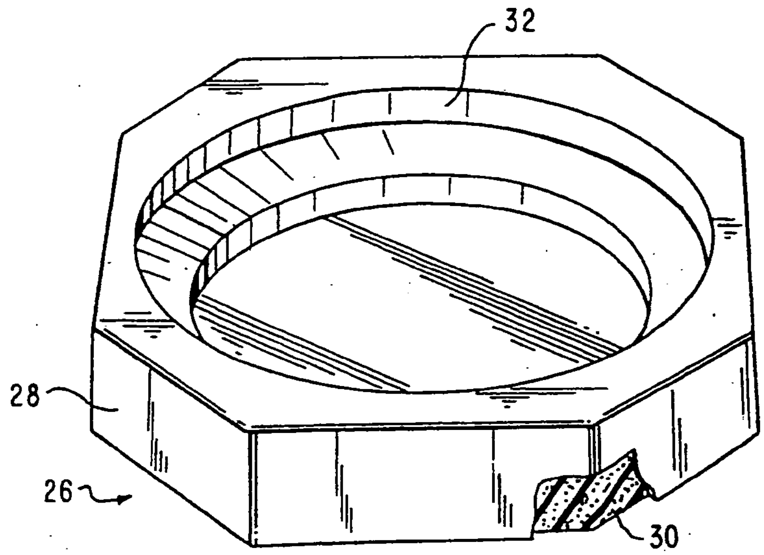


FIG. 4

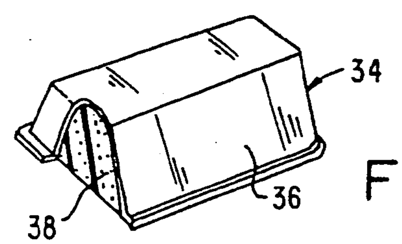


FIG.5

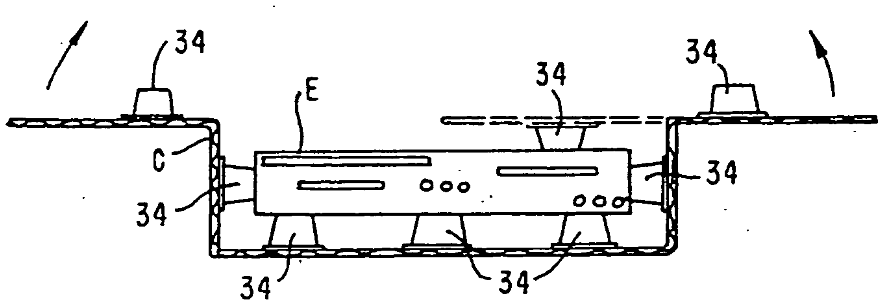


FIG.6

FIG. 8

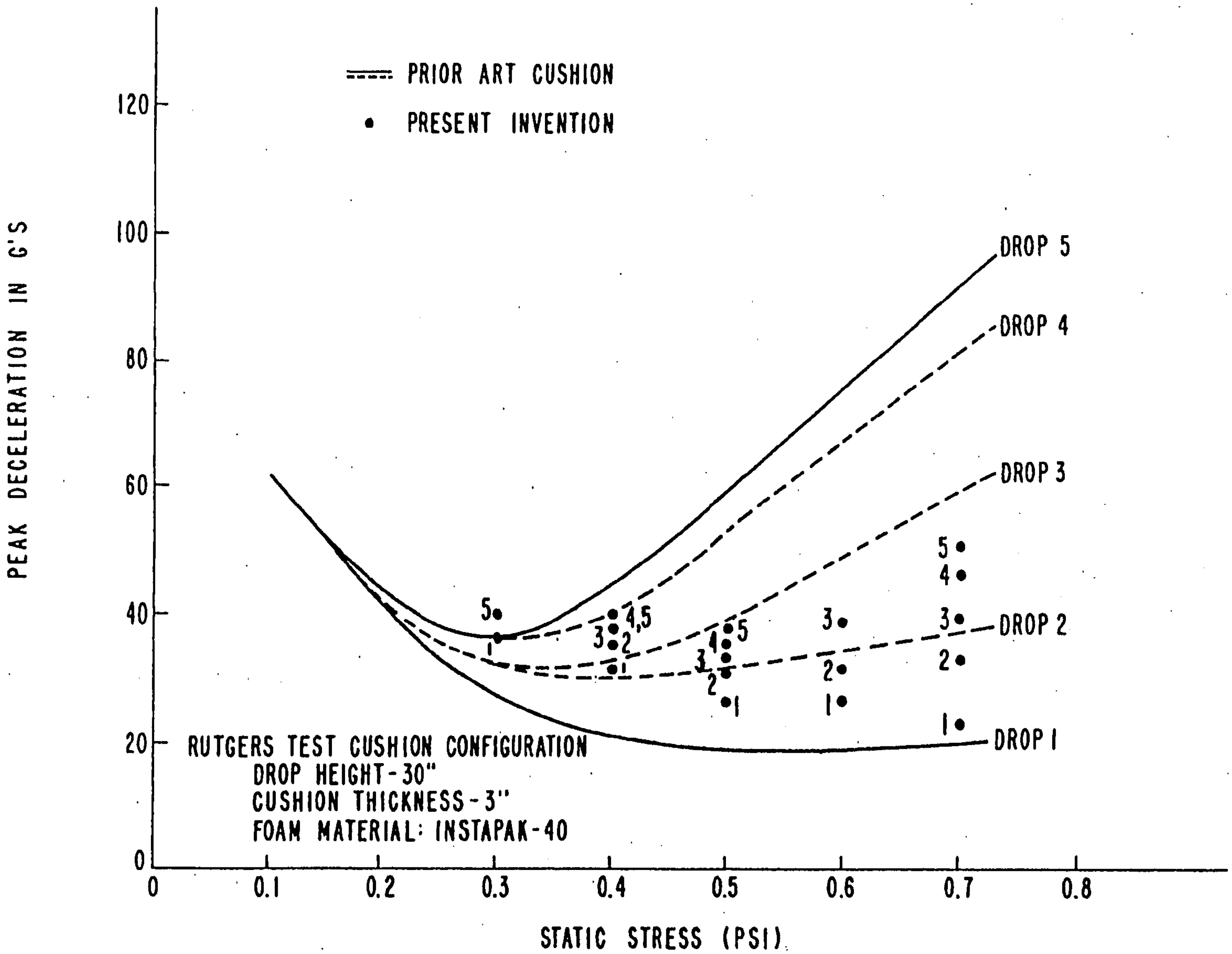
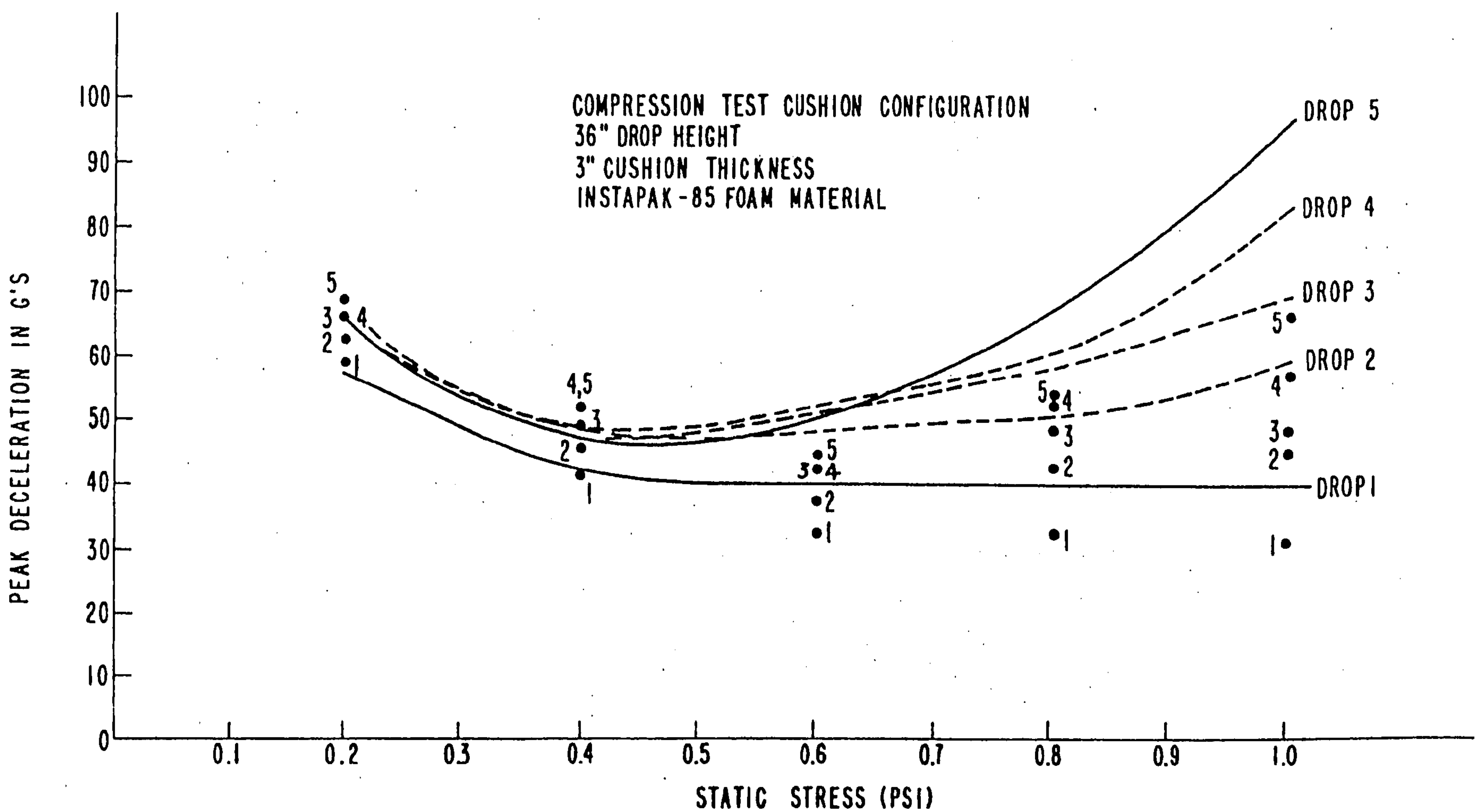

PRIOR ART CUSHION
PRESENT INVENTION
PEAK DECELERATION IN G'S
120
100
80
60
40
20
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
STATIC STRESS (PSI)
DROP 5
DROP 4
DROP 3
DROP 2
DROP I
RUTGERS TEST CUSHION CONFIGURATION
DROP HEIGHT-30"
CUSHION THICKNESS-3"
FOAM MATERIAL: INSTAPAK-40

FIG. 10


COMPRESSION TEST CUSHION CONFIGURATION
36" DROP HEIGHT
3" CUSHION THICKNESS
INSTAPAK-85 FOAM MATERIAL
DROP 5
DROP 4
DROP 3
DROP 2
DROP 1
PEAK DECELERATION IN G'S
STATIC STRESS (PSI)
0
10
20
30
40
50
60
70
80
90
100
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 155 109**
A3

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 85301272.2

(51) Int. Cl.⁴: **B 65 D 81/06**

(22) Date of filing: 26.02.85

(30) Priority: 07.03.84 US 587182

(43) Date of publication of application: 18.09.85 Bulletin 85/38

(88) Date of deferred publication of search report: 06.08.86

(84) Designated Contracting States: BE CH DE FR GB IT LI NL SE

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(54) Method of packing objects and packing therefor.

(57) A cushion packing for protecting an object to be packed in a container and methods for the use thereof are disclosed. The cushion packing comprises a dimensionally stable outer shell (12, 28 or 36) forming a chamber (18) therein of a predetermined configuration related to the object to be protected and related to a container for packaging same, a lower density foam material (14, 30 or 38) disposed within and substantially filling and conforming to the shape of said chamber (18) formed in said outer shell (12), said foam material having a molded density of less than or equal to 1.5 pounds per cubic foot when disposed in said chamber, and said outer shell filled with said foam material being adapted to be disposed in said container for said object and placed in contact with a portion of said object to thereby support and protect said object when pakaged in said container against shock and vibrational loads.

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